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ABSTRACT

This study proposed that performing a low-demand secondary task would improve a subject's control of attentional processes on a primary task of importance. Subjects were 60 public elementary school students 9, 10, or 11 years of age. Of these, 30 had been identified as learning disabled and 30 had been identified as non-learning-disabled. Each group of 30 was comprised of 15 boys and 15 girls. The primary task (consonant shadowing) involved repeating aloud groups of letters consisting of three consonants each. The secondary task (psychomotor) consisted of a simple video game intended to require little conscious attention while controlling attentional processes and minimizing potential distraction. The experiment included five separate tasks or performance periods of 5 minutes each. The first two tasks were used to establish performance baselines for primary and secondary tasks. The remaining three tasks involved the primary task with the addition of a distracting event, the combined performance of the primary and secondary tasks, and combined performance with distracting event. Results indicated that performance on the primary task was adversely affected by the introduction of a secondary task. Primary task performance was not significantly affected by subject's sex or diagnostic category. (Author/RH)

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Primary Task Performance as Affected by Secondary Task Involvement

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Purpose of the Study: This study attempted to enhance an individual's ability to achieve and sustain attention by involving him/her in a controlled task that was secondary to a primary performance task.

Procedure: Subjects for this study were 9-, 10-, and 11-year-old students enrolled in a public elementary school. A total of 60 subjects was involved, of whom 30 had been identified as learning disabled and 30 had been identified as non-learning-disabled. Each group of 30 students was comprised of 15 boys and 15 girls. The primary task (consonant shadowing) involved repeating aloud groups of letters consisting of three consonants each. The secondary task (psychomotor) consisted of a simple video game. It was intended to require little conscious attention while controlling attentional processes and minimizing potential distraction. The experimental procedure included five separate tasks or performance periods of 5 minutes

each. The first two tasks were used to establish performance baselines for the primary and secondary tasks. The remaining three tasks involved the primary task with the addition of a distracting event (an audio alarm), the combined performance of the primary and secondary tasks, and this combined performance with the distracting event.

Findings: It was anticipated that the secondary task would provide an attentional control function resulting in improved performance on the primary task. The analysis of variance indicated a significant difference in performance among the treatment levels, F (2, 112) = 15.75, $p < .01$, with the combination of primary and secondary tasks being the source of this effect. The combination of primary and secondary tasks resulted in performance decrement on the primary task. Primary task performance was not significantly affected by the subject's gender or diagnostic category. Performance measures also were recorded for the secondary task, with no significant differences noted for the treatment conditions, gender, or diagnostic category. A significant three-way-interaction effect was noted for these three factors, F (1, 56) = 6.62, $p < .05$.

Conclusions: The results indicated that performance on the primary task was adversely affected by the introduction of a secondary task. Primary performance was not significantly affected by factors of gender or diagnostic category. Additional investigation may be required to clarify the effects of various client characteristics and task characteristics on performance.

Primary Task Performance as Affected by Secondary Task Involvement

An individual's ability to receive information, manipulate it, and respond appropriately seems to be directly related to attentional processes, or the ability to direct his/her efforts to the tasks at hand. Examination of these processes indicates that attention is limited in capacity. Theories of attention have addressed this issue of capacity limitation in several ways. Certain theories have proposed that attentional capacity is restricted at a specific point in the processing system. Theories of this type have become known as bottleneck theories of attention because the restriction, or bottleneck, was thought to occur at a particular point. Examples of such theories include those of Broadbent (1958), Deutsch and Deutsch (1963), and Treisman (1964).

Other theories have assumed that there is a general limit to attentional capacity but have not specified the exact point of this limitation. An example of such a capacity model of attention was provided by Kahneman (1973). Rather than assuming that capacity limitations occur at a particular stage, Kahneman argued that a flexible allocation of a limited capacity occurs, which might result in

attempts to exceed one's capacity at various points in the process.

An important issue in these theories, as well as in associated research, is the limit of attentional capacity and the mechanisms used to control attentional processes. The current study was designed to investigate the use of a specific task as such an attentional control mechanism. It was an attempt to enhance an individual's ability to achieve and sustain attention by involving him/her in a controlled task that was secondary to a primary attention task. If the secondary task is such that it can be accomplished through nearly involuntary control rather than focused attention, it should demand little of the unallocated attentional capacity that is available to the individual. Examples of such low-demand tasks might be walking, turning the pages in a book while reading, and driving a car. Although these tasks usually are accomplished with little conscious attention, they do require that the individual supply the supervision necessary to maintain task performance. As a result, they monitor and direct ongoing attentional processes in a predictable controlled manner.

The current study proposed that involvement in such a secondary task would improve the subject's

ability to control attentional processes, both on the secondary task and on a primary task of importance. Controlled use of previously unallocated capacity would result in a more efficient attentional allocation than if the individual were left in a more unstructured state, with much of his/her capacity free for competing and disruptive task allocation. Although the nearly automatic secondary task would require attentional capacity, by its nature it would demand less capacity than many other potentially less controlled objects of attentional allocation. The overall effect would be that, over time, performance on the primary task would be enhanced by the addition of the secondary task, and this enhancement would be accomplished with minimal investment of attentional capacity.

Much of the research produced in the area of attentional processes has sought to clarify the relationship between processes involved in attention and processes involved in learning and performance. As a result, much of the work in attention has been directed toward educational investigations and applications. This study was of a similar nature. A major point in question was whether the addition of a nearly involuntary secondary task to a previously defined primary task would result in enhanced

performance on the primary task. The research also attempted to clarify whether such enhancement was greater for subjects identified as having learning disabilities than for subjects not so identified. Additionally, it attempted to clarify whether such benefits were greater for male subjects than for female subjects. This study also examined performance on the secondary task in terms of significant differences in performance between subjects identified as learning disabled and those not so identified and significant differences in performance between male subjects and female subjects.

Method

Subjects

Subjects for this study were 9-, 10-, and 11-year-old students enrolled in a public elementary school. This study required a total of 60 subjects, 30 of whom had been identified as learning disabled and 30 of whom had been identified as non-learning-disabled. Each group of 30 students was comprised of 15 boys and 15 girls.

Apparatus and Procedure

Certain sections of this study involved the use of audio tapes for administration of a series of consonant groups. These consonant groups were randomly

produced, resulting in groups such as DXT, HKS, CLH, and so forth. These consonant groups were presented at 3-second intervals, with the subject repeating the consonant unit aloud during the interval. Actual presentation of the consonant groups was made by use of headphones that were provided for the subject.

Certain sections of this procedure also involved manipulation of a simple video game that was developed for this project. This game resembled a video form of table tennis similar to commercially available games.

Some of the tasks also included the use of a distracting event. This event was produced by the introduction of an auditory cue (a beeper), which could be terminated by pressing a button on the apparatus.

The complete study required the participation of 60 subjects in a series of tasks that required approximately an hour for completion for each subject. The experimental procedure included five separate tasks, or performance periods. Each task was performed for a 5-minute period. The first two tasks were the same for all subjects and were used to establish performance baselines. The remaining three tasks were performed by all subjects, but the order of performance

was determined by standard counterbalancing procedures.

The baseline trial for the primary task consisted only of repeating the consonant groups as they were presented. The baseline trial for the secondary task consisted only of performing the video-game task. Additional trials included performance of the primary task with the introduction of the distracting event, the combined performance of the primary and secondary tasks, and the combined performance with the addition of distraction.

A Between-Between-Within (B-B-W) Three-Factor Mised Design was used for this study. Tests were made for performance differences on the primary task among the levels of Factor A (baseline/three treatment levels), two levels of Factor B (learning disabled/ non-learning-disabled), and two levels of Factor C (boys/girls). The same design was used to test performance differences on the secondary task. Tests were made for differences among the levels of Factor A (baseline/two treatment levels), two levels of Factor B (learning disabled/non-learning-disabled), and two levels of Factor C (boys/girls).

Results and Discussion

Analysis of the data revealed significant differences in performance in only two cases. One

difference was noted in primary task performance, and one was noted in secondary task performance. When a subject was required to perform the primary and secondary tasks simultaneously--that is, shadow the consonants and play the video game--performance on the primary task declined.

On the secondary task, a performance difference was significant only when the factors of treatment condition, diagnostic category, and gender were considered in interaction. When these interaction effects were considered, significant differences were noted only when the primary and secondary tasks were combined and a distracting event was introduced. Specifically, a significant performance difference was noted between learning-disabled boys and non-learning-disabled boys as well as between non-learning-disabled boys and non-learning-disabled girls. Although all three groups showed improvement in secondary task performance, learning-disabled boys and non-learning-disabled girls displayed more improvement when compared with non-learning-disabled boys.

These results are contrary to the original prediction that the addition of a secondary task would result in improved performance on a primary

task. This prediction was based on the development of a means of managing residual or unallocated capacity. A primary objective in this study was to involve the previous unallocated capacity in a task that could be accomplished with minimal conscious attention. This process conceivably could be achieved by engaging the subject in a nearly automatic task. The secondary task (video game) of the current study was designed to provide such a task. However, observations made during the procedure indicated that the secondary task did not achieve this purpose. The video game failed to provide a task that could be brought to automaticity during the period of the study. It provided a simple psychomotor task but one that also was very discontinuous. The subject was involved in the game in a continuous process, but its demands on him fluctuated significantly. As a result, it is likely that this psychomotor task did not provide an opportunity for developing a nearly continuous process of interaction that could approach automatic function.

Further evidence of fluctuation in involvement was observed in primary task performance. During performance periods, it became obvious that the cadence for repetition of consonants was affected by the game sequence. It became apparent that the

subject was changing the pattern of interaction by alternating attention between the two tasks involved.

If a nearly automatic level of functioning was not achieved, the paradigm basically became a procedure involving two competing tasks. Such a format likely would produce conflicting demands and alternation of attention and performance as previously noted. In such a setting, both tasks would become primary, and neither would perform the desired secondary control function.

The results obviously do not confirm the hypothesized improvement in primary task performance. However, this predicted improvement was based on the assumption that the secondary task would be nearly automatic. Without such a task, the results may not adequately address the primary point of interest. Additional study is required to investigate further the effect of secondary task involvement on primary task performance. Obviously, a critical issue to be addressed in such research is the development of a secondary task that will achieve a high level of automaticity. Such a task likely will be a simple, highly repetitive task that demands continuous, consistent performance. It also must be a task that will not interfere directly with performance of the

primary task. This will allow both tasks to be performed simultaneously without direct physical interference. Psychomotor tasks involving simple assembly operations or tracking skills might be appropriate tasks to consider.

Additional research also should address factors associated with primary task characteristics. For pragmatic reasons, it seems appropriate to involve the primary task with operations typically associated with information processing. This might result in primary tasks concerned with reading, writing, and listening to verbal information. In this way, performance on the primary task may be more easily related to other learning events and conditions. It would be helpful to develop a task that demands fairly continuous performance. In this way, the problems associated with timing and alternation of attention may be avoided. It also would be helpful if a means could be devised to continuously monitor performance. This would result in more sensitivity to momentary fluctuations in attention as reflected in performance. With careful consideration given to concerns such as these, additional research could examine and, hopefully, clarify the impact of multiple-task involvement on attentional allocation.

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